Water budgets of the two Olentangy River experimental wetlands in 1999

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Introduction

Water budgets in terms of hydrologic conditions are extremely important for the maintenance of wetland structure and function, this is because biota, the nutrient of water quality and vegetation dynamic can only be determined in the context of wetland's overall water budget (Mitsch and Gosselink, 2000). Since 1994, a combination of manual and automated observations has been providing a wealth of information on the daily, and even hourly, water fluxes of the two experimental wetlands at the Olentangy River Wetland Research Park (ORWRP). Annual water budgets at the ORWRP were presented by Mitsch (1995), Wu et al. (1995), Nairn et al. (1996), Wang et al. (1997), Wang et al. (1998) and Wang and Mitsch (1999). These reports, however, provided estimates of daily water fluxes and flooding events of the two Olentangy River experimental wetlands for each year. As part of a long-term wetland and ecosystem study (Mitsch, 2000), the water budget for 1999 is part of this research. To allow water budgets to be compiled on a consistent basis, there is a need that we follow previous procedures and modeling approaches with integrating observations, in part because of the very abundance of data and also because of the periodic occurrence of atypical events such as floods and equipment malfunctions. These procedures were used as a model in developing the 1999 wetland water budgets.

Methods

Locations of the inflow and outflow reading were shown in Figure 1. The following general equation (Mitsch and Gosselink, 1993) was used to determine a water budget for each ORWRP experimental wetland:

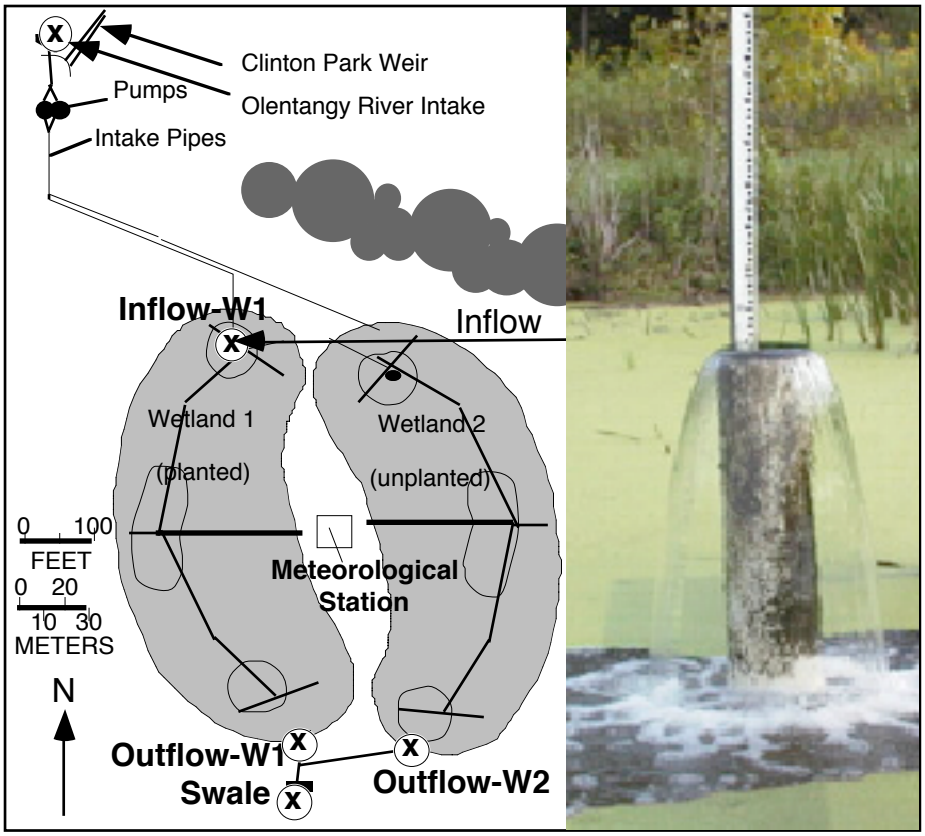

Figure 1. Location of pumped inflow and outflow of Wetland 1 and Wetland 2 at ORWRP. Hydrologic sampling stations are marked and the inflow of Wetland 1 is shown on the right.

$$S_i + F_i + P - S_o - ET - G_o - \Delta V = 0 \qquad (1)$$

where,

S_i = pumped inflow (surface)
F_i = flood inflow (due to floods on the Olentangy River)
P = precipitation
S_o = surface outflow
ET = evapotranspiration
G_o = ground water outflow (seepage)
ΔV = change in volume

All parameters were developed in equivalent units for a budget calculation; either average flow rate (i.e., gpm) over a given time period, or total depth (i.e., cm) over a given time period, where total area was taken as a nominal 10,000 m^3 (1 ha) for each wetland.

A 4-hour time increment was used as the basis for computing all parameters in 1999. However, the budget is reported only for daily values.

Pumped Inflow (S_i)

Twice-daily (morning and evening) readings of both instantaneous and total integrated volume of pumping rates have been generally collected by staff and students from the flow monitors in each pipe going to each wetland. Many gaps have continued to exist in the data when flow gages clogged or when readings were missed (Figure 2). When data from only one wetland inflow were available, the missing flow rate was assumed to be the same as the available flow rate (the protocol for the experimental wetlands has been, since the start, to deliver the same flow to each wetland at all times). When both flow gages were malfunctioning, flow was estimated for both from the best estimate of previous readings or from pump settings (number of turns open). When pumps were shut down, either by site managers or through accident, the time of shutdown was estimated from field records and flow was prorated for only the period when pumps were operating.

For the 1999 budget, readings from the inflow meters were interpolated to determine 4-hour total flow increments, in gallons, for each wetland. Water level recorder data charts, when available, were used to determine exact times of power outages or other unusual occurrences.

Flood Inflow (F_i)

There was no surface flood on the site in 1999.

Precipitation (P)

Precipitation was measured on half-hour frequency with a Unidata Model 6506B tipping bucket rain gage located in the on-site meteorological station located between the two experimental wetlands. When the gage was not working during winter, precipitation data were obtained from two-per-day site monitoring of 3 precipitation gages that were emptied after each recording or from liquid precipitation data from the OSU Agronomy Farm weather station, located 1 km from the ORWRP. The half-hourly precipitation data from the on-site weather station were used to derive 4-hour precipitation totals. Liquid precipitation in the form of snow was not easily accounted for during winter.

Surface Outflow (S_o)

Outflow measurements from the experimental wetlands are based on wetland water level and the status of the control weir boxes constructed at the southern edge of the basins. The three important variables needed are: 1) the water level in the basins: 2) the status of weirs or other control devices in the weir boxes; and 3) the crest elevation of the weir or other control device. These data are then used with weir equations that relate head to rate of outflow. When outflow was blocked with debris, outflow was estimated from equation 1.

Wetland Water Level

From the beginning of the project, water level has been recorded twice-per-day by reading a staff gauge located near the outflow. Figure 2 shows staff gauge and outflow outlet for W1. Beginning in early 1996, water level was continuously recorded by Stevens Type F water level recorders located in the southernmost deep pool of each wetland and accessible by boardwalk. Recordings were set to 1:1 scale and charts are changed weekly. Water levels were graphically determined from chart records at 4-hour intervals.

Figure 2. Staff gauge and outflow weir box of Wetland 1.

Weir Box Status

Four different conditions of weir box outflow control occurred since 1995: v-notch plate in place (V+0); v-notch and one stoplog in place (V+1); v-notch and two stoplogs in place (V+2); no v-notch or stoplog (noweir). Details of computering outflow with v-notch were given in Wang and Mitsch (1999). However, major hydrological events are presented in Table 1, and no weir plate was in the place for wetlands 1 and 2 in 1999.

Flow Equations with No Weir

Rating curves developed from velocity readings in the outflow pipes downstream of the weirs were used to estimate outflow. These empirical equations are:

$$\text{for Wetland 1: } S_o = 0.310\ H^{3.490} \quad (2)$$

$$\text{for Wetland 2: } S_o = 0.467\ H^{2.747} \quad (3)$$

where

S_o = outflow, cfs,
H = head, feet

The head here is the elevation above the bottom of the empty weir box.

Evapotranspiration (ET)

For 1999, pan evaporation data from the on-site weather station were used and corrected using a factor of 0.75.

Seepage to Ground Water (G_o)

Changes in wetland volume during these periods that were not accounted for by precipitation or evapotranspiration could be used to estimate seepage, as follows:

$$G_o = -\Delta V + P - ET \quad (4)$$

Table 1. Major hydrology events affecting ORWRP hydrology during the year 1999.

Date and time	pump change		Weir code	Date and time	pump change		Weir code
1/20/99 8:45	off	off	no weir	3/16/99 14:45	off	off	no weir
1/20/99 16:45	off	on	no weir	3/16/99 14:50	on	off	no weir
1/21/99 8:35	off	off	no weir	3/16/99 15:00	off	off	no weir
1/21/99 19:15	on	off	no weir	3/16/99 15:10	on	off	no weir
1/22/99 8:40	off	off	no weir	4/23/99 19:55	off	off	no weir
1/22/99 10:51	on	off	no weir	4/30/99 10:30	on	off	no weir
1/22/99 15:10	off	off	no weir	6/6/99 9:30	off	off	no weir
1/22/99 15:25	off	on	no weir	6/8/99 18:25	on	off	no weir
1/23/99 8:10	off	off	no weir	6/23/99 8:50	off	off	no weir
1/23/99 12:00	on	off	no weir	6/23/99 18:00	on	off	no weir
1/25/99 7:27	off	off	no weir	7/1/99 8:30	off	off	no weir
1/25/99 10:00	on	off	no weir	7/2/99 0:00	on	off	no weir
1/25/99 10:35	off	off	no weir	7/9/99 8:25	off	off	no weir
1/25/99 10:45	on	off	no weir	7/9/99 8:30	on	off	no weir
1/25/99 16:00	off	off	no weir	7/25/99 9:35	off	off	no weir
1/25/99 16:05	on	off	no weir	7/25/99 10:09	on	off	no weir
1/28/99 8:00	off	off	no weir	8/6/99 19:00	off	off	no weir
1/28/99 0:00	on	off	no weir	8/9/99 10:55	on	off	no weir
1/29/99 8:30	off	off	no weir	8/24/99 10:15	off	off	no weir
1/29/99 8:50	on	off	no weir	8/26/99 9:26	on	off	no weir
2/10/99 17:25	off	off	no weir	8/26/99 11:20	off	off	no weir
2/10/99 18:28	on	off	no weir	8/27/99 15:30	on	off	no weir
2/16/99 9:00	off	off	no weir	10/24/99 10:15	off	off	no weir
2/16/99 18:15	on	off	no weir	10/24/99 10:15	on	off	no weir
3/5/99 8:15	off	off	no weir	12/17/99 13:17	off	off	no weir
3/5/99 10:00	on	off	no weir	12/17/99 13:20	off	on	no weir
3/9/99 9:50	off	off	no weir				
3/9/99 9:55	on	off	no weir				

*Weir code (Wang and Mitsch, 1999)

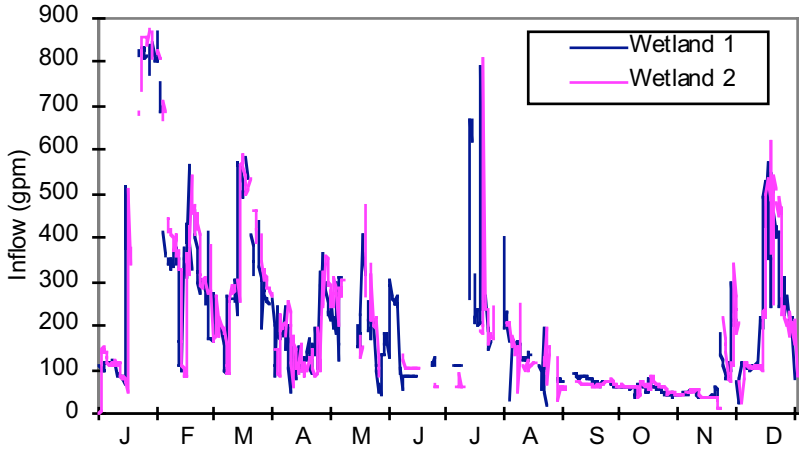

Figure 3. Pumped inflow of Wetland 1 and Wetland 2 in 1999.

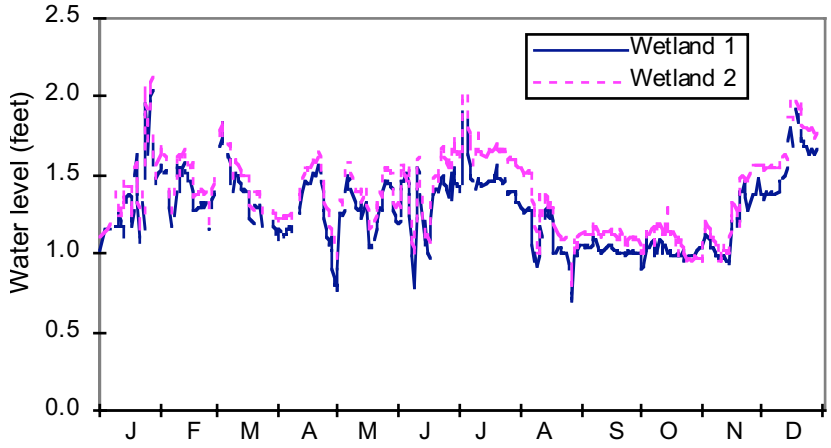

Figure 4. Water level of Wetland 1 and Wetland 2 in 1999.

Time periods during which the no-inflow/no-outflow criteria were satisfied (see Appendix A) occurred when pumps were shut down, either for drawdown or for maintenance reasons, and wetland water levels were below the weir. However, no such periods were observed during 1999. We treated residual in the water budget as seepage to ground water.

Change in Volume (ΔV)

Net change in wetland volume over any given period was determined using beginning and ending water level and a known relationship between water level and wetland volume. Net change was calculated from charts on an every-four-hour basis and was used to calculate the water budget on a four-hour basis.

Results and Discussion

Figures 3 and 4 show pumped inflows and water levels of both Wetland 1 and Wetland 2 in 1999. Annual and monthly hydrologic budgets were summarized for 1999 (Table 3). In 1999, inflows to Wetland 1 and 2 were 30.2 m and 31.4 m , respectively. Surface outflow for 1999 was estimated to be 27.5 m and 28.3 m respectively for Wetland 1 and 2. They were approximately 91% and 90% of pumped inflow. Daily flows on which these budgets were based are attached in Appendix A. Highest daily pumped values were 785 gpm and 827 gpm in January 24, 1999 for W1 and W2, respectively, and highest daily water level readings to Wetland 1 and Wetland 2 were 2.04 feet and 2.15 feet, respectively. Figure 5 shows cumulative daily outflow vs cumulative daily inflow of the two Olentangy River experimental wetlands in 1999. The average retention time in 1999 was 4.35 - 4.45 day, By comparison, the retention time was 1.8-2.0 day in 1998, 1-2 day in 1997, and 5.3-5.6 day in 1996.

References

Mitsch, W.J. 1996. Olentangy river stream flow and flooding in 1995. In: W.J. Mitsch, ed., Olentangy River Wetland Research Park at The Ohio State University, Annual Report 1995, pp. 29-36.

Table 3. Monthly and annual water budgets of the two Olentangy River experimental wetlands in 1999.

	W 1 (m)							W2 (m)					
Month	Inf.	Outf.	Precip.	Evap.	ΔVol	Seep.	Month	Inf.	Outf.	Precip.	Evap.	ΔVol	Seep.
Jan	4.1	4.0	0.1	0.0	0.0	0.1	Jan	4.3	4.2	0.1	0.0	0.1	0.0
Feb	3.7	3.2	0.1	0.1	-0.1	0.5	Feb	3.9	3.3	0.1	0.1	-0.1	0.7
Mar	4.0	3.5	0.0	0.1	0.0	0.5	Mar	4.2	3.4	0.0	0.1	0.0	0.7
Apr	2.2	2.3	0.1	0.0	0.0	-0.1	Apr	2.3	2.4	0.1	0.0	0.0	0.0
May	3.2	2.4	0.0	0.1	0.1	0.7	May	3.3	2.6	0.0	0.1	0.0	0.0
Jun	1.5	2.0	0.1	0.0	-0.1	-0.4	Jun	1.4	2.0	0.1	0.0	-0.1	-0.5
Jul	3.2	2.7	0.0	0.2	0.0	0.3	Jul	3.1	2.7	0.0	0.2	0.0	0.2
Aug	1.3	1.3	0.0	0.1	0.0	-0.1	Aug	1.3	1.5	0.0	0.1	0.0	-0.2
Sep	1.1	0.8	0.0	0.1	0.0	0.3	Sep	1.1	0.9	0.0	0.1	0.0	0.1
Oct	0.8	0.7	0.0	0.1	0.0	0.0	Oct	0.9	0.8	0.0	0.1	0.0	0.0
Nov	1.5	1.5	0.0	0.0	0.1	0.0	Nov	1.5	1.6	0.0	0.0	0.1	0.0
Dec	3.6	3.9	0.1	0.0	-0.1	-0.1	Dec	4.1	4.0	0.1	0.0	-0.1	0.3
Total	30.2	28.4	0.6	0.9	-0.1	1.7	Total	31.4	29.5	0.6	0.9	0.0	1.2

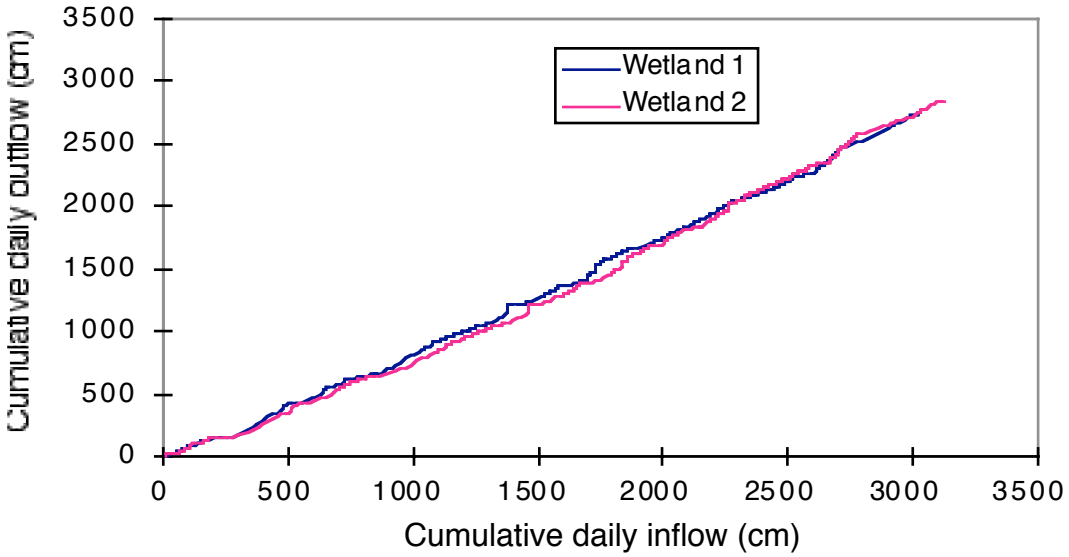

Figure 5. Cumulative daily outflow vs cumulative daily inflow during the year 1999.

Mitsch, W.J. and J. G. Gosselink. 1993. Wetlands, 2rd Ed. Van Nostrand Reinhod. New York, pp76.

Mitsch, W.J., V. Bouchard, L. Zhang and M. Hunter. 2000. Biogeochemical and nutrient removal patterns of created riparia wetlands: Sixth-year results. In: W.J. Mitsch and L. Zhang, eds., Olentangy River Wetland Research Park at The Ohio State University, Annual Report 1999, pp, 83-90.

Mitsch, W.J. and J. G. Gosselink. 2000. Wetlands, 3rd Ed. Van Nostrand Reinhod. New York, pp67.

Mitsch, W.J., X.Wu and N. Wang. 1995. Establishing a weather station at the Olentangy River Research Park. In: W.J. Mitsch, ed., Olentangy River Wetland Research Park at The Ohio State University, Annual Report 1994, pp, 47-49.

Nairn, R.W., N. Wang, R.J.F. Bruins and W.J. Mitsch. 1996. Hydrology budgets of the Olentangy River wetlands. In: W.J. Mitsch, ed., Olentangy River Wetland Research Park at The Ohio State University, Annual Report 1995, pp. 69-81.

Wang, N. and W.J. Mitsch. 1999. Water Budgets of the two Olentangy River experimental wetlands in 1998. In: W.J. Mitsch and V. Bouchard, eds., Olentangy River Wetland Research Park at The Ohio State

University, Annual Report 1998, pp. 17-36.

Wang, N., H. Montgomery and W.J. Mitsch. 1998. Water budgets of the two Olentangy River experimental wetlands in 1997. In. W.J. Mitsch and V. Bouchard, eds., Olentangy River Wetland Research Park at The Ohio State University, Annual Report 1997, pp. 33-50.

Wu, X., W.J. Mitsch, R.J.F. Bruins and J. Koreny. 1995. A water budgets of the Olentangy River wetlands. In: W.J. Mitsch and X. Wu, eds., Olentangy River Wetland Research Park at The Ohio State University, Annual Report 1994, pp. 69-81

Appendix A. Daily water budgets (cm) of the two Olentangy River experimental wetlands in 1999.

	W 1, cm							W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
1/1/99	6.0	6.0	0.0	0.0	0.0	0.0	1/1/99	6.0	6.0	0.0	0.0	0.0	0.0
1/2/99	5.8	6.0	1.6	0.0	-5.1	6.6	1/2/99	8.0	6.0	1.6	0.0	-5.0	8.7
1/3/99	5.7	0.8	0.2	0.0	1.8	3.2	1/3/99	7.8	0.9	0.2	0.0	1.9	5.2
1/4/99	5.6	2.6	0.0	0.0	0.9	2.1	1/4/99	7.7	2.9	0.0	0.0	0.2	4.5
1/5/99	5.6	3.5	0.0	0.1	1.0	1.1	1/5/99	7.6	3.1	0.0	0.1	0.3	4.2
1/6/99	8.1	4.5	0.0	0.1	0.0	3.6	1/6/99	10.6	3.4	0.0	0.1	0.1	7.0
1/7/99	6.8	4.5	0.1	0.2	0.0	2.2	1/7/99	7.6	3.5	0.1	0.2	0.2	3.8
1/8/99	6.1	4.5	0.0	0.1	0.1	1.3	1/8/99	6.0	3.7	0.0	0.1	0.6	1.6
1/9/99	7.3	4.7	0.1	0.0	0.0	2.7	1/9/99	7.4	4.3	0.1	0.0	0.0	3.2
1/10/99	6.1	4.7	0.0	0.1	0.3	1.1	1/10/99	5.9	4.3	0.0	0.1	3.0	-1.4
1/11/99	6.2	4.9	0.0	0.1	0.0	1.2	1/11/99	6.0	7.3	0.0	0.1	0.9	-2.2
1/12/99	6.5	4.9	0.8	0.2	1.0	1.2	1/12/99	6.3	8.1	0.8	0.2	-2.6	1.4
1/13/99	6.3	5.9	0.6	0.2	-0.9	1.7	1/13/99	6.3	5.6	0.6	0.2	0.7	0.4
1/14/99	5.4	5.0	0.0	0.2	-1.0	1.2	1/14/99	5.2	6.2	0.0	0.2	1.6	-2.7
1/15/99	4.5	4.0	0.0	0.1	1.2	-0.8	1/15/99	4.2	7.8	0.0	0.1	0.3	-3.9
1/16/99	4.7	5.2	1.0	0.1	4.1	-3.6	1/16/99	4.5	8.1	1.0	0.1	1.0	-3.6
1/17/99	4.4	9.3	0.6	0.2	0.8	-5.4	1/17/99	4.1	9.0	0.6	0.2	0.4	-5.0
1/18/99	14.6	10.1	0.1	0.2	9.1	-4.7	1/18/99	14.3	9.4	0.1	0.2	9.8	-5.0
1/19/99	20.1	19.2	0.0	0.1	-6.6	7.4	1/19/99	20.5	19.2	0.0	0.1	-7.1	8.4
1/20/99	9.8	5.6	0.1	0.2	2.6	1.5	1/20/99	10.1	8.2	0.1	0.2	5.5	-3.7
1/21/99	5.6	8.2	1.0	0.2	5.5	-7.3	1/21/99	5.7	13.7	1.0	0.2	2.7	-9.9
1/22/99	17.1	13.7	0.0	0.0	2.7	0.7	1/22/99	17.2	16.4	0.0	0.0	19.2	-18.4
1/23/99	16.3	16.4	0.0	0.1	5.5	-5.7	1/23/99	17.0	35.6	0.0	0.1	-8.2	-10.4
1/24/99	43.0	35.6	0.0	0.0	-4.4	11.8	1/24/99	45.3	27.4	0.0	0.0	11.0	7.0
1/25/99	17.5	27.4	0.0	0.1	5.5	-15.4	1/25/99	18.0	38.3	0.0	0.1	-0.2	-20.2
1/26/99	42.3	38.3	0.0	0.1	-0.2	4.1	1/26/99	42.8	38.2	0.0	0.1	-8.8	13.4
1/27/99	42.4	38.2	0.0	0.0	-8.8	13.1	1/27/99	42.8	29.4	0.0	0.0	-1.4	14.9
1/28/99	34.8	29.4	0.0	0.1	-1.4	6.8	1/28/99	35.4	27.9	0.0	0.1	-3.3	10.6
1/29/99	16.2	27.9	0.0	0.2	-3.3	-8.6	1/29/99	17.6	24.6	0.0	0.2	0.0	-7.3
1/30/99	17.2	24.6	0.0	0.2	-1.6	-6.0	1/30/99	21.5	24.6	0.0	0.2	-2.8	-0.5
1/31/99	7.9	23.1	0.0	0.1	-7.2	-8.0	1/31/99	13.0	21.8	0.0	0.1	-6.4	-2.4
2/1/99	18.3	15.8	0.5	0.4	-0.7	3.3	2/1/99	21.3	15.4	0.5	0.4	0.3	5.8
2/2/99	19.0	15.1	0.3	0.2	1.1	2.8	2/2/99	21.0	15.7	0.3	0.2	1.8	3.6
2/3/99	20.0	16.3	0.0	0.0	0.8	2.9	2/3/99	19.5	17.4	0.0	0.0	-0.3	2.3
2/4/99	15.3	17.1	0.1	0.1	-1.5	-0.3	2/4/99	14.8	17.1	0.1	0.1	-0.9	-1.4
2/5/99	7.0	15.6	0.0	0.4	-0.2	-8.8	2/5/99	6.9	16.2	0.0	0.4	-1.3	-8.4
2/6/99	5.4	15.4	0.1	0.6	-1.2	-9.3	2/6/99	5.0	14.9	0.1	0.6	-1.9	-8.4
2/7/99	9.8	14.2	2.3	0.5	-6.1	3.6	2/7/99	9.4	13.0	2.3	0.5	-5.1	3.4
2/8/99	19.9	8.1	0.0	0.5	-3.1	14.5	2/8/99	20.7	7.9	0.0	0.5	-2.4	14.8
2/9/99	22.6	5.0	0.0	0.4	2.1	15.2	2/9/99	22.8	5.5	0.0	0.4	2.6	14.4
2/10/99	14.5	7.1	0.0	0.1	7.2	0.2	2/10/99	16.7	8.0	0.0	0.1	5.6	3.1
2/11/99	20.2	14.3	0.0	0.1	2.5	3.3	2/11/99	22.4	13.6	0.0	0.1	1.8	6.9
2/12/99	20.3	16.7	0.4	0.3	-3.5	7.1	2/12/99	21.7	15.4	0.4	0.3	-2.0	8.3

	W 1, cm						W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
2/13/99	16.7	13.2	0.0	0.5	3.1	-0.2	2/13/99	18.7	13.5	0.0	0.5	3.0	1.8
2/14/99	16.7	16.4	0.0	0.5	1.4	-1.5	2/14/99	18.8	16.4	0.0	0.5	1.2	0.7
2/15/99	14.1	17.8	0.0	0.1	-2.4	-1.4	2/15/99	14.9	17.7	0.0	0.1	-2.3	-0.5
2/16/99	4.7	15.4	0.2	0.1	-1.5	-9.0	2/16/99	4.8	15.4	0.2	0.1	-1.4	-9.1
2/17/99	10.5	13.9	0.2	0.0	-1.0	-2.3	2/17/99	10.6	14.0	0.2	0.0	-0.4	-2.8
2/18/99	11.1	12.9	0.0	0.1	-4.5	2.7	2/18/99	11.3	13.5	0.0	0.1	-4.1	1.8
2/19/99	11.4	8.4	0.0	0.1	0.0	2.9	2/19/99	11.4	9.5	0.0	0.1	-0.5	2.2
2/20/99	13.1	8.4	0.0	0.2	-1.0	5.5	2/20/99	12.8	9.0	0.0	0.2	-1.1	4.7
2/21/99	11.2	7.4	0.0	0.4	0.4	3.0	2/21/99	11.1	7.9	0.0	0.4	0.6	2.3
2/22/99	10.6	7.8	0.0	0.1	0.1	2.6	2/22/99	10.3	8.4	0.0	0.1	0.2	1.6
2/23/99	8.6	7.9	0.0	0.2	0.4	0.1	2/23/99	9.1	8.6	0.0	0.2	0.1	0.2
2/24/99	5.3	8.4	0.1	0.6	-0.4	-3.1	2/24/99	5.6	8.7	0.1	0.6	-0.7	-2.9
2/25/99	5.4	7.9	0.5	0.4	-0.4	-2.1	2/25/99	5.1	8.1	0.5	0.4	-0.1	-2.8
2/26/99	12.4	7.5	0.0	0.5	-2.9	7.3	2/26/99	13.8	8.0	0.0	0.5	-2.8	8.2
2/27/99	13.7	4.6	1.4	0.3	0.5	9.6	2/27/99	14.8	5.1	1.4	0.3	-0.3	11.1
2/28/99	13.8	5.1	0.2	0.3	3.7	4.9	2/28/99	13.9	4.8	0.2	0.3	4.0	5.0
3/1/99	16.4	8.8	0.0	0.3	1.5	5.8	3/1/99	16.7	8.8	0.0	0.3	1.8	5.7
3/2/99	29.7	10.3	0.2	0.1	0.7	18.8	3/2/99	29.4	10.6	0.2	0.1	0.4	18.5
3/3/99	30.1	11.0	0.5	0.2	3.7	15.8	3/3/99	30.5	11.0	0.5	0.2	3.1	16.8
3/4/99	27.6	14.7	0.0	0.3	16.1	-3.5	3/4/99	28.5	14.1	0.0	0.3	9.0	5.1
3/5/99	20.9	30.8	0.0	0.4	-22.0	11.7	3/5/99	22.8	23.1	0.0	0.4	-14.3	13.6
3/6/99	16.4	8.8	1.7	0.4	16.4	-7.5	3/6/99	16.7	8.8	1.7	0.4	14.1	-4.9
3/7/99	20.5	25.2	0.0	0.1	-7.6	2.8	3/7/99	24.5	22.9	0.0	0.1	-5.2	6.7
3/8/99	14.0	17.7	0.0	0.1	3.0	-6.8	3/8/99	17.4	17.7	0.0	0.1	1.0	-1.5
3/9/99	8.9	20.7	0.4	0.3	-1.7	-10.0	3/9/99	8.8	18.8	0.4	0.3	-0.4	-9.5
3/10/99	17.1	19.0	0.0	0.4	-4.7	2.5	3/10/99	18.3	18.4	0.0	0.4	-5.0	4.6
3/11/99	16.2	14.3	0.0	0.3	-1.9	3.5	3/11/99	17.6	13.4	0.0	0.3	-2.3	6.2
3/12/99	16.1	12.4	0.0	0.4	2.4	0.9	3/12/99	17.2	11.1	0.0	0.4	3.2	2.6
3/13/99	14.8	14.8	0.0	0.4	-0.8	0.3	3/13/99	15.8	14.3	0.0	0.4	-0.7	1.8
3/14/99	13.8	14.0	0.0	0.4	-1.0	0.3	3/14/99	15.0	13.6	0.0	0.4	-0.5	1.5
3/15/99	12.4	13.1	0.0	0.5	-1.4	0.2	3/15/99	13.5	13.1	0.0	0.5	-1.3	1.3
3/16/99	7.4	11.7	0.0	0.1	-0.6	-3.7	3/16/99	5.7	11.8	0.0	0.1	-0.5	-5.7
3/17/99	10.9	11.1	0.0	0.1	-0.2	-0.1	3/17/99	7.7	11.3	0.0	0.1	0.1	-3.9
3/18/99	7.5	10.9	0.0	0.3	-1.3	-2.3	3/18/99	6.4	11.5	0.0	0.3	-1.4	-3.9
3/19/99	9.0	9.6	0.0	0.1	-3.6	2.9	3/19/99	8.4	10.1	0.0	0.1	-3.8	2.0
3/20/99	10.6	6.0	0.0	0.1	-0.5	5.0	3/20/99	10.8	6.3	0.0	0.1	-0.5	4.8
3/21/99	9.4	5.5	0.0	0.3	0.3	3.3	3/21/99	10.3	5.8	0.0	0.3	0.3	3.9
3/22/99	9.3	5.8	0.0	0.4	1.9	1.2	3/22/99	10.3	6.2	0.0	0.4	2.0	1.7
3/23/99	7.8	7.7	0.0	0.5	-0.1	-0.3	3/23/99	8.6	8.2	0.0	0.5	0.0	0.0
3/24/99	7.7	7.7	0.0	0.3	-0.4	0.1	3/24/99	9.3	8.2	0.0	0.3	-0.6	1.4
3/25/99	7.1	7.3	0.0	0.6	-1.7	0.8	3/25/99	7.4	7.6	0.0	0.6	-2.0	1.2
3/26/99	9.1	5.6	0.0	0.5	0.4	2.5	3/26/99	9.2	5.6	0.0	0.5	0.8	2.3
3/27/99	8.6	6.0	0.0	0.3	-0.9	3.2	3/27/99	8.6	6.4	0.0	0.3	-0.6	2.4
3/28/99	6.3	5.1	0.0	0.4	0.0	0.9	3/28/99	6.2	5.8	0.0	0.4	0.0	0.1
3/29/99	5.0	5.0	0.0	0.4	0.1	-0.4	3/29/99	5.2	5.8	0.0	0.4	0.0	-0.9
3/30/99	5.0	5.1	0.0	0.4	0.2	-0.7	3/30/99	5.5	5.8	0.0	0.4	-0.1	-0.6
3/31/99	5.2	5.3	0.0	0.1	-0.2	0.0	3/31/99	5.4	5.7	0.0	0.1	-0.2	-0.1
4/1/99	4.8	5.1	0.2	0.1	-0.9	0.8	4/1/99	4.7	5.5	0.2	0.1	-0.8	0.1
4/2/99	6.8	4.1	0.0	0.1	-0.2	2.7	4/2/99	6.3	4.7	0.0	0.1	-0.1	1.7
4/3/99	7.5	4.0	0.3	0.1	0.4	3.3	4/3/99	7.3	4.6	0.3	0.1	0.2	2.7
4/4/99	5.8	4.4	0.1	0.2	-0.2	1.4	4/4/99	5.7	4.8	0.1	0.2	-0.1	1.0
4/5/99	6.6	4.3	0.0	0.2	-0.4	2.6	4/5/99	5.8	4.7	0.0	0.2	0.1	0.9
4/6/99	8.1	3.8	0.0	0.1	0.3	3.9	4/6/99	6.9	4.7	0.0	0.1	0.2	1.9
4/7/99	7.0	4.1	0.0	0.1	0.4	2.4	4/7/99	6.4	4.9	0.0	0.1	0.0	1.4
4/8/99	6.4	4.5	0.2	0.1	0.4	1.7	4/8/99	6.1	5.0	0.2	0.1	0.3	1.0
4/9/99	5.6	4.8	1.1	0.2	-0.1	1.8	4/9/99	5.2	5.2	1.1	0.2	-0.1	1.0
4/10/99	9.2	4.8	0.0	0.2	-0.4	4.8	4/10/99	9.4	5.1	0.0	0.2	-0.5	4.5

	W 1, cm						W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
4/11/99	5.6	4.3	0.0	0.2	0.6	0.5	4/11/99	5.6	4.7	0.0	0.2	0.4	0.3
4/12/99	7.4	5.0	0.1	0.1	1.0	1.3	4/12/99	7.3	5.1	0.1	0.1	0.1	2.0
4/13/99	10.0	5.9	0.0	0.1	0.9	3.1	4/13/99	11.3	5.2	0.0	0.1	0.9	5.2
4/14/99	14.8	6.1	0.0	0.1	2.1	6.6	4/14/99	14.8	6.1	0.0	0.1	2.1	6.6
4/15/99	13.7	8.2	0.7	0.1	2.9	3.2	4/15/99	14.5	8.2	0.7	0.1	2.7	4.2
4/16/99	12.7	11.1	0.2	0.2	2.2	-0.5	4/16/99	14.0	10.8	0.2	0.2	2.0	1.1
4/17/99	14.0	13.3	0.1	0.1	-0.6	1.3	4/17/99	15.5	12.9	0.1	0.1	0.1	2.5
4/18/99	13.1	12.6	0.5	0.0	0.0	0.9	4/18/99	16.9	13.0	0.5	0.0	-0.1	4.5
4/19/99	10.9	12.6	0.1	0.2	0.3	-2.1	4/19/99	15.4	12.9	0.1	0.2	0.3	2.1
4/20/99	10.5	12.9	0.0	0.1	1.9	-4.3	4/20/99	14.4	13.2	0.0	0.1	1.3	-0.2
4/21/99	11.8	14.8	2.2	0.1	-0.1	-0.7	4/21/99	15.0	14.5	2.2	0.1	-0.3	2.9
4/22/99	12.5	14.6	0.0	0.2	0.0	-2.3	4/22/99	15.1	14.2	0.0	0.2	0.3	0.5
4/23/99	2.4	14.6	1.8	0.2	1.9	-12.5	4/23/99	2.3	14.5	1.8	0.2	1.6	-12.1
4/24/99	0.0	16.5	0.0	0.1	-2.9	-13.7	4/24/99	0.0	16.1	0.0	0.1	-2.6	-13.6
4/25/99	0.0	13.7	0.0	0.1	-5.5	-8.2	4/25/99	0.0	13.5	0.0	0.1	-4.7	-8.8
4/26/99	0.0	8.1	0.0	0.2	-2.6	-5.6	4/26/99	0.0	8.8	0.0	0.2	-2.2	-6.7
4/27/99	0.0	5.5	0.1	0.2	-1.5	-4.1	4/27/99	0.0	6.6	0.1	0.2	-0.5	-6.1
4/28/99	0.0	4.0	0.0	0.2	-0.8	-3.4	4/28/99	0.0	6.0	0.0	0.2	-1.6	-4.6
4/29/99	0.0	3.2	0.0	0.1	-0.4	-3.0	4/29/99	0.0	4.4	0.0	0.1	-1.2	-3.4
4/30/99	8.7	2.9	0.0	0.0	-1.3	7.0	4/30/99	7.6	3.3	0.0	0.0	-0.2	4.5
5/1/99	13.1	1.6	0.0	0.2	-0.8	12.2	5/1/99	9.7	3.0	0.0	0.2	-0.7	7.2
5/2/99	14.5	0.8	0.0	0.1	0.4	13.1	5/2/99	7.7	2.4	0.0	0.1	-1.2	6.4
5/3/99	9.5	1.3	0.0	0.0	2.2	6.1	5/3/99	6.7	1.1	0.0	0.0	2.1	3.5
5/4/99	14.3	3.4	0.0	0.0	3.0	7.9	5/4/99	15.2	3.2	0.0	0.0	3.3	8.7
5/5/99	16.6	6.4	0.2	0.0	0.3	10.1	5/5/99	26.5	6.5	0.2	0.0	0.4	19.8
5/6/99	9.9	6.7	0.0	0.1	3.0	0.1	5/6/99	8.8	6.9	0.0	0.1	4.0	-2.2
5/7/99	12.0	9.7	0.2	0.0	12.4	-10.0	5/7/99	13.2	10.9	0.2	0.0	12.9	-10.4
5/8/99	20.9	22.1	0.0	0.1	-8.4	7.2	5/8/99	27.5	23.8	0.0	0.1	-9.6	13.3
5/9/99	11.7	13.7	0.0	0.0	-1.4	-0.5	5/9/99	13.2	14.2	0.0	0.0	-1.5	0.6
5/10/99	11.9	12.3	0.0	0.1	-2.0	1.5	5/10/99	9.8	12.7	0.0	0.1	-2.0	-0.9
5/11/99	11.2	10.3	0.0	0.2	-1.2	2.0	5/11/99	9.0	10.7	0.0	0.2	-1.4	-0.5
5/12/99	11.7	9.1	0.0	1.4	-1.1	2.3	5/12/99	11.5	9.3	0.0	1.4	-0.7	1.5
5/13/99	7.6	7.9	0.0	0.0	-0.5	0.2	5/13/99	7.5	8.6	0.0	0.0	0.0	-1.1
5/14/99	5.8	7.5	0.1	0.0	0.7	-2.3	5/14/99	5.5	8.6	0.1	0.0	0.2	-3.2
5/15/99	5.8	8.2	0.0	0.1	-2.4	-0.2	5/15/99	5.4	8.8	0.0	0.1	-2.1	-1.3
5/16/99	5.8	5.9	0.0	0.3	0.0	-0.4	5/16/99	5.4	6.7	0.0	0.3	0.0	-1.6
5/17/99	4.0	5.8	0.0	0.0	0.0	-1.8	5/17/99	3.9	6.7	0.0	0.0	0.0	-2.8
5/18/99	3.2	5.8	0.0	0.0	0.0	-2.5	5/18/99	3.2	6.7	0.0	0.0	0.0	-3.4
5/19/99	5.0	5.8	0.2	0.0	-3.0	2.3	5/19/99	5.0	6.7	0.2	0.0	-3.0	1.5
5/20/99	7.2	2.8	0.0	0.0	0.2	4.3	5/20/99	7.2	3.6	0.0	0.0	0.2	3.4
5/21/99	9.0	2.9	0.0	0.0	0.6	5.5	5/21/99	9.0	3.8	0.0	0.0	0.6	4.6
5/22/99	9.4	3.5	0.0	2.3	1.7	1.8	5/22/99	9.4	4.4	0.0	2.3	1.5	1.2
5/23/99	11.2	5.2	1.3	0.0	0.5	6.7	5/23/99	11.2	5.9	1.3	0.0	0.7	5.9
5/24/99	15.9	5.7	0.3	0.1	1.4	8.9	5/24/99	15.9	6.5	0.3	0.1	1.3	8.2
5/25/99	14.4	7.1	0.8	0.2	2.6	5.2	5/25/99	14.4	7.8	0.8	0.2	2.2	5.0
5/26/99	14.3	9.7	0.0	0.1	3.3	1.3	5/26/99	14.3	10.0	0.0	0.1	2.7	1.6
5/27/99	13.4	13.0	0.0	0.3	0.3	-0.2	5/27/99	13.4	12.7	0.0	0.3	0.3	0.1
5/28/99	15.3	13.4	0.0	0.1	-0.5	2.4	5/28/99	15.6	13.0	0.0	0.1	-0.4	2.8
5/29/99	4.0	12.8	0.0	0.1	-0.7	-8.3	5/29/99	9.5	12.7	0.0	0.1	-0.5	-2.8
5/30/99	4.6	12.1	0.0	0.5	-4.7	-3.3	5/30/99	7.7	12.2	0.0	0.5	-4.8	-0.2
5/31/99	4.2	7.4	0.1	0.0	0.0	-3.1	5/31/99	5.8	7.4	0.1	0.0	0.0	-1.5
6/1/99	4.2	7.4	0.2	0.1	-1.6	-1.5	6/1/99	5.8	7.4	0.2	0.1	-1.2	-0.3
6/2/99	4.8	5.7	0.0	0.0	-0.3	-0.6	6/2/99	5.9	6.2	0.0	0.0	0.0	-0.3
6/3/99	4.9	5.4	0.0	0.2	1.3	-2.0	6/3/99	6.0	6.2	0.0	0.2	0.8	-1.2
6/4/99	4.7	6.7	0.0	0.1	5.7	-7.8	6/4/99	5.7	7.0	0.0	0.1	4.8	-6.2
6/5/99	4.7	12.4	0.0	0.2	0.9	-8.7	6/5/99	5.8	11.8	0.0	0.2	0.4	-6.6
6/6/99	0.9	13.3	0.0	0.1	1.3	-13.9	6/6/99	1.1	12.2	0.0	0.1	-1.3	-9.9

	W 1, cm						W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
6/7/99	0.0	14.6	0.0	0.2	-2.6	-12.2	6/7/99	0.0	10.9	0.0	0.2	1.3	-12.5
6/8/99	3.3	12.0	0.0	0.2	-5.0	-3.9	6/8/99	3.3	12.2	0.0	0.2	-4.9	-4.1
6/9/99	5.4	7.0	0.0	0.2	-4.7	2.9	6/9/99	5.4	7.3	0.0	0.2	-4.4	2.3
6/10/99	5.4	2.3	0.0	0.2	-0.8	3.7	6/10/99	5.4	2.9	0.0	0.2	-0.3	2.6
6/11/99	7.4	1.5	0.0	0.2	6.5	-0.8	6/11/99	7.4	2.6	0.0	0.2	5.8	-1.1
6/12/99	2.7	8.0	0.0	0.3	6.7	-12.3	6/12/99	2.7	8.3	0.0	0.3	5.5	-11.4
6/13/99	4.4	14.7	1.1	0.0	-3.1	-6.1	6/13/99	4.4	13.9	1.1	0.0	-2.2	-6.1
6/14/99	5.3	11.6	0.0	0.0	-6.0	-0.4	6/14/99	4.4	11.6	0.0	0.0	-6.1	-1.2
6/15/99	6.4	5.6	0.0	0.1	-2.4	3.1	6/15/99	3.4	5.5	0.0	0.1	-2.5	0.4
6/16/99	6.1	3.2	0.0	0.0	0.9	2.0	6/16/99	3.7	3.0	0.0	0.0	-0.1	0.8
6/17/99	5.9	4.0	0.0	0.1	-1.7	3.5	6/17/99	5.7	2.9	0.0	0.1	0.0	2.8
6/18/99	6.0	2.3	0.0	0.1	0.9	2.7	6/18/99	6.0	2.8	0.0	0.1	0.9	2.1
6/19/99	6.0	3.2	0.0	0.2	2.3	0.2	6/19/99	6.0	3.7	0.0	0.2	1.7	0.2
6/20/99	6.0	5.5	0.0	0.5	0.1	0.0	6/20/99	6.0	5.5	0.0	0.5	0.1	0.0
6/21/99	6.0	5.5	0.0	0.6	0.5	-0.7	6/21/99	6.0	5.5	0.0	0.6	0.5	-0.7
6/22/99	5.9	6.0	0.0	0.0	-1.1	1.0	6/22/99	5.9	6.0	0.0	0.0	-1.1	1.0
6/23/99	3.1	4.9	0.0	0.0	0.5	-2.3	6/23/99	3.1	4.9	0.0	0.0	0.5	-2.3
6/24/99	6.0	5.5	0.0	0.0	0.0	0.5	6/24/99	6.0	5.5	0.0	0.0	0.0	0.5
6/25/99	6.0	5.5	0.0	0.1	0.0	0.4	6/25/99	5.6	5.5	0.0	0.1	0.0	0.1
6/26/99	5.5	5.5	1.2	0.1	0.1	1.1	6/26/99	3.5	5.5	1.2	0.1	0.1	-0.9
6/27/99	4.4	5.6	1.4	0.0	-0.7	0.9	6/27/99	2.5	5.6	1.4	0.0	-0.7	-1.0
6/28/99	4.3	4.9	0.1	0.0	0.0	-0.5	6/28/99	2.5	4.9	0.1	0.0	0.0	-2.4
6/29/99	6.0	4.9	0.0	0.1	2.2	-1.3	6/29/99	3.4	4.9	0.0	0.1	2.2	-3.8
6/30/99	6.6	7.2	3.1	0.5	-6.1	8.1	6/30/99	3.8	7.2	3.1	0.5	-6.1	5.3
7/1/99	1.0	1.1	0.0	0.7	7.1	-7.9	7/1/99	0.5	1.1	0.0	0.7	7.1	-8.3
7/2/99	12.1	8.2	0.0	0.7	4.0	-0.8	7/2/99	12.1	8.2	0.0	0.7	4.0	-0.8
7/3/99	35.8	12.2	0.0	0.6	-2.2	25.1	7/3/99	35.7	12.2	0.0	0.6	-2.2	25.1
7/4/99	31.1	10.0	0.0	1.0	4.0	16.1	7/4/99	20.6	10.0	0.0	1.0	4.0	5.6
7/5/99	19.7	14.0	0.0	0.6	-2.5	7.7	7/5/99	19.7	14.0	0.0	0.6	-2.5	7.7
7/6/99	12.2	11.5	0.0	0.4	0.0	0.3	7/6/99	6.2	11.5	0.0	0.4	0.0	-5.6
7/7/99	11.6	11.5	0.0	0.8	2.2	-2.8	7/7/99	11.6	11.5	0.0	0.8	2.2	-2.9
7/8/99	14.2	13.7	1.5	0.9	-2.7	3.9	7/8/99	13.7	13.7	1.5	0.9	-2.7	3.3
7/9/99	9.7	11.0	0.0	0.8	0.0	-2.0	7/9/99	7.5	11.0	0.0	0.8	0.0	-4.2
7/10/99	11.8	11.0	0.0	0.7	-1.9	2.1	7/10/99	8.8	11.0	0.0	0.7	-1.9	-1.0
7/11/99	9.6	9.0	0.0	0.7	0.3	-0.4	7/11/99	4.8	9.0	0.0	0.7	0.3	-5.2
7/12/99	8.9	9.3	0.0	0.6	0.2	-1.2	7/12/99	10.4	9.3	0.0	0.6	0.2	0.3
7/13/99	9.8	9.5	0.0	0.3	1.5	-1.4	7/13/99	16.6	9.5	0.0	0.3	1.5	5.4
7/14/99	11.8	11.0	0.0	0.7	1.3	-1.1	7/14/99	21.7	11.0	0.0	0.7	1.3	8.8
7/15/99	13.7	12.2	0.0	1.4	-5.6	5.8	7/15/99	26.7	12.2	0.0	1.4	-5.6	2.7
7/16/99	7.3	6.6	0.0	1.3	-4.7	4.1	7/16/99	8.0	6.6	0.0	1.3	-4.7	4.8
7/17/99	2.2	1.9	0.0	1.0	0.3	-1.0	7/17/99	3.5	1.9	0.0	1.0	0.3	0.3
7/18/99	2.4	2.2	0.4	1.0	0.0	-0.4	7/18/99	3.8	2.2	0.4	1.0	0.0	1.0
7/19/99	1.7	2.2	1.1	0.7	-1.1	1.0	7/19/99	2.7	2.2	1.1	0.7	-1.1	2.0
7/20/99	0.7	1.1	1.1	0.7	2.7	-2.6	7/20/99	1.2	1.1	1.1	0.7	2.7	-2.2
7/21/99	3.6	3.8	0.0	0.7	10.4	-11.3	7/21/99	1.1	3.8	0.0	0.7	10.4	13.8
7/22/99	15.3	14.2	0.0	0.5	-0.5	1.2	7/22/99	9.4	14.2	0.0	0.5	-0.5	-4.7
7/23/99	12.5	13.7	0.0	0.9	-4.4	2.3	7/23/99	11.2	13.7	0.0	0.9	-4.4	1.0
7/24/99	9.2	9.3	0.0	0.6	-4.1	3.4	7/24/99	7.5	9.3	0.0	0.6	-4.1	1.8
7/25/99	5.3	5.2	0.0	0.5	4.1	-4.5	7/25/99	5.9	5.2	0.0	0.5	4.1	-4.0
7/26/99	9.4	9.3	0.0	0.6	-0.5	0.1	7/26/99	8.0	9.3	0.0	0.6	-0.5	-1.4
7/27/99	9.0	8.8	0.0	0.6	-0.5	0.2	7/27/99	7.0	8.8	0.0	0.6	-0.5	-1.8
7/28/99	8.7	8.2	0.0	0.5	2.1	-2.2	7/28/99	3.4	8.2	0.0	0.5	2.1	-7.5
7/29/99	8.4	10.4	0.0	0.5	-0.5	-2.0	7/29/99	4.9	10.4	0.0	0.5	-	
7/30/99	10.3	9.9	0.0	0.5	-5.5	5.4	7/30/99	9.5	9.9	0.0	0.5	-5.5	4.6
7/31/99	4.5	4.4	0.0	0.4	1.6	-1.9	7/31/99	5.9	4.4	0.0	0.4	1.6	-0.4
8/1/99	6.2	6.0	0.0	0.3	0.5	-0.6	8/1/99	6.4	6.0	0.0	0.3	0.5	-0.5
8/2/99	6.6	6.6	0.0	0.2	0.0	-0.1	8/2/99	5.8	6.6	0.0	0.2	0.0	-1.0
8/3/99	6.8	6.6	0.0	0.2	0.0	0.1	8/3/99	5.7	6.6	0.0	0.2	0.0	-1.0

	W 1, cm						W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
8/4/99	7.0	6.6	0.0	0.2	0.7	-0.5	5.6	6.6	0.0	0.2	0.7	-1.8
8/5/99	7.0	7.3	0.0	0.4	-0.2	-0.5	5.8	7.3	0.0	0.4	0.0	-1.9
8/6/99	4.8	7.1	0.0	0.4	0.3	-2.9	4.0	7.3	0.0	0.4	0.0	-3.7
8/7/99	0.0	7.4	0.0	0.3	0.0	-7.6	0.0	7.3	0.0	0.3	0.0	-7.6
8/8/99	0.0	7.4	0.0	0.3	-4.6	-3.0	0.0	7.3	0.0	0.3	-4.1	-3.5
8/9/99	2.8	2.7	0.0	0.4	0.7	-1.0	3.4	3.3	0.0	0.4	4.5	-4.9
8/10/99	6.1	3.4	0.0	0.4	-1.4	3.6	8.0	7.8	0.0	0.4	-2.7	2.5
8/11/99	8.9	2.1	0.0	0.7	-0.5	6.7	9.8	5.1	0.0	0.7	-3.3	7.3
8/12/99	5.4	1.6	0.1	0.5	2.0	1.4	5.9	1.8	0.1	0.5	2.1	1.6
8/13/99	6.1	3.6	0.0	0.6	1.0	1.0	8.0	3.9	0.0	0.6	2.8	0.7
8/14/99	2.2	4.5	0.0	0.3	0.1	-1.0	8/14/99	7.7	6.8	0.0	0.3	-1.4	2.0
8/15/99	3.6	4.6	0.0	0.5	2.5	-4.0	8/15/99	7.5	5.3	0.0	0.5	2.4	-0.7
8/16/99	4.3	7.1	0.0	0.8	0.1	-3.6	8/16/99	7.3	7.7	0.0	0.8	-0.2	-1.0
8/17/99	4.2	7.1	0.0	1.2	-0.8	-3.3	8/17/99	3.6	7.5	0.0	1.2	-0.9	-4.2
8/18/99	3.2	6.3	0.0	0.8	0.3	-4.2	8/18/99	1.9	6.6	0.0	0.8	-0.3	-5.2
8/19/99	2.3	6.7	0.0	0.7	-3.4	-1.6	8/19/99	2.4	6.4	0.0	0.7	-1.6	-3.0
8/20/99	3.7	3.3	0.0	0.6	-1.0	0.9	8/20/99	3.1	4.8	0.0	0.6	-1.0	-1.1
8/21/99	4.3	2.3	0.0	0.3	0.1	1.6	8/21/99	3.4	3.7	0.0	0.3	-0.4	-0.2
8/22/99	4.2	2.4	0.0	0.2	0.3	1.2	8/22/99	3.3	3.4	0.0	0.2	-0.3	-0.1
8/23/99	4.4	2.7	0.0	0.2	-0.3	1.7	8/23/99	3.3	3.1	0.0	0.2	-0.3	0.3
8/24/99	2.7	2.4	0.0	0.2	0.0	0.1	8/24/99	2.1	2.8	0.0	0.2	-0.1	-0.8
8/25/99	0.2	2.4	0.0	0.3	-0.1	-2.4	8/25/99	0.2	2.7	0.0	0.3	0.0	-2.8
8/26/99	3.3	2.3	0.0	0.3	-0.2	0.8	8/26/99	2.5	2.7	0.0	0.3	-0.1	-0.4
8/27/99	2.0	2.1	0.0	0.3	-0.7	0.3	8/27/99	1.7	2.6	0.0	0.3	-0.9	-0.3
8/28/99	3.8	1.4	0.0	0.3	-0.5	2.7	8/28/99	3.2	1.7	0.0	0.3	-0.6	1.9
8/29/99	4.8	0.9	0.0	0.3	-0.4	4.0	8/29/99	4.0	1.1	0.0	0.3	-0.5	3.1
8/30/99	4.6	0.5	0.0	0.3	1.3	2.5	8/30/99	3.7	0.6	0.0	0.3	1.5	1.4
8/31/99	4.5	1.8	0.0	0.1	0.4	2.2	8/31/99	2.6	2.1	0.0	0.1	0.2	0.1
9/1/99	4.5	2.2	0.0	0.4	0.2	1.7	9/1/99	3.1	2.3	0.0	0.4	0.3	0.1
9/2/99	4.5	2.4	0.0	0.1	0.4	1.6	9/2/99	4.3	2.6	0.0	0.1	0.5	1.1
9/3/99	4.6	2.8	0.0	0.1	0.1	1.6	9/3/99	3.8	3.2	0.0	0.1	0.1	0.3
9/4/99	4.8	2.9	0.0	0.3	-0.2	1.7	9/4/99	3.9	3.3	0.0	0.3	-0.1	0.3
9/5/99	4.6	2.7	1.8	0.8	0.0	2.9	9/5/99	3.7	3.2	1.8	0.8	-0.1	1.6
9/6/99	4.4	2.7	0.0	0.0	0.1	1.5	9/6/99	3.5	3.1	0.0	0.0	0.0	0.3
9/7/99	4.4	2.8	0.0	0.0	0.0	1.6	9/7/99	3.5	3.1	0.0	0.0	0.1	0.3
9/8/99	4.3	2.8	0.0	0.1	0.4	1.1	9/8/99	3.4	3.2	0.0	0.1	0.3	-0.2
9/9/99	4.2	3.2	0.0	0.0	0.3	0.7	9/9/99	3.4	3.6	0.0	0.0	0.3	-0.5
9/10/99	3.4	3.5	0.0	1.3	-0.3	-1.1	9/10/99	3.5	3.9	0.0	1.3	-0.2	-1.4
9/11/99	3.7	3.2	0.0	0.0	-0.6	1.1	9/11/99	3.9	3.7	0.0	0.0	-0.5	0.7
9/12/99	3.8	2.6	0.0	0.0	-0.2	1.4	9/12/99	4.0	3.2	0.0	0.0	-0.2	1.0
9/13/99	4.0	2.4	0.0	0.5	0.0	1.1	9/13/99	4.1	3.0	0.0	0.5	0.0	0.7
9/14/99	4.0	2.4	0.0	0.2	0.2	1.3	9/14/99	4.2	3.0	0.0	0.2	0.2	0.7
9/15/99	4.1	2.5	0.0	0.2	0.1	1.2	9/15/99	4.2	3.2	0.0	0.2	0.1	0.7
9/16/99	4.0	2.7	0.0	0.1	0.2	1.0	9/16/99	4.1	3.4	0.0	0.1	0.0	0.6
9/17/99	3.5	2.9	0.0	0.2	0.1	0.3	9/17/99	3.6	3.4	0.0	0.2	0.0	-0.1
9/18/99	3.4	2.9	0.2	1.0	-0.1	-0.2	9/18/99	3.4	3.4	0.2	1.0	-0.1	-0.6
9/19/99	3.1	2.8	0.1	0.2	-0.3	0.5	9/19/99	3.3	3.3	0.1	0.2	-0.2	0.1
9/20/99	3.4	2.5	0.0	0.2	0.0	0.7	9/20/99	3.5	3.1	0.0	0.2	-0.1	0.4
9/21/99	3.3	2.5	0.0	1.0	-0.2	-0.1	9/21/99	3.4	2.9	0.0	1.0	-0.2	-0.3
9/22/99	3.3	2.3	0.0	0.1	0.0	0.9	9/22/99	3.5	2.7	0.0	0.1	0.5	0.2
9/23/99	3.2	2.3	0.0	0.1	0.1	0.8	9/23/99	3.3	3.2	0.0	0.1	-0.1	0.2
9/24/99	3.2	2.4	0.0	0.2	0.0	0.6	9/24/99	2.6	3.1	0.0	0.2	-0.3	-0.4
9/25/99	3.3	2.4	0.1	0.0	-0.2	1.1	9/25/99	2.9	2.8	0.1	0.0	-0.4	0.6
9/26/99	3.2	2.2	0.0	0.3	0.2	0.5	9/26/99	3.3	2.4	0.0	0.3	0.1	0.5
9/27/99	3.1	2.5	1.9	0.0	0.0	2.6	9/27/99	3.2	2.5	1.9	0.0	0.3	2.3
9/28/99	3.2	2.4	0.1	0.0	-0.1	0.9	9/28/99	3.3	2.8	0.1	0.0	0.0	0.6
9/29/99	3.1	2.4	0.0	0.0	-0.1	0.9	9/29/99	3.1	2.8	0.0	0.0	0.0	0.3

	W 1, cm						W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
9/30/99	2.5	2.3	0.0	0.1	0.0	0.1	9/30/99	2.8	2.8	0.0	0.1	-0.1	0.0
10/1/99	2.6	2.3	0.0	0.0	0.0	0.2	10/1/99	2.9	2.7	0.0	0.0	-0.4	0.5
10/2/99	3.5	2.3	0.1	0.0	-0.3	1.5	10/2/99	3.6	2.3	0.1	0.0	-0.5	1.9
10/3/99	3.3	2.1	0.1	0.0	-0.7	2.0	10/3/99	3.6	1.8	0.1	0.0	-0.1	2.0
10/4/99	3.2	1.4	0.0	0.0	0.3	1.5	10/4/99	3.5	1.7	0.0	0.0	0.3	1.5
10/5/99	3.1	1.7	0.0	0.1	1.3	0.1	10/5/99	3.5	2.0	0.0	0.1	1.1	0.3
10/6/99	3.9	3.0	0.0	1.9	0.2	-1.2	10/6/99	4.7	3.1	0.0	1.9	0.0	-0.3
10/7/99	3.7	3.2	0.3	2.2	-0.4	-1.0	10/7/99	4.3	3.1	0.3	2.2	0.1	-0.8
10/8/99	3.2	2.8	0.8	0.0	0.4	0.7	10/8/99	3.7	3.2	0.8	0.0	0.6	0.7
10/9/99	3.2	3.3	0.2	0.2	-0.6	0.5	10/9/99	3.7	3.8	0.2	0.2	-0.9	0.7
10/10/99	2.9	2.7	0.0	1.3	0.4	-1.5	10/10/99	3.4	2.9	0.0	1.3	-0.3	-0.5
10/11/99	3.3	3.1	0.0	0.1	-0.4	0.5	10/11/99	3.8	2.6	0.0	0.1	1.5	-0.4
10/12/99	3.0	2.7	0.9	0.0	0.7	0.5	10/12/99	3.5	4.1	0.9	0.0	-0.1	0.4
10/13/99	2.7	3.4	0.0	2.0	-0.8	-1.9	10/13/99	3.1	4.0	0.0	2.0	-0.4	-2.4
10/14/99	2.3	2.6	0.0	0.2	0.1	-0.6	10/14/99	2.6	3.6	0.0	0.2	-0.2	-0.9
10/15/99	2.2	2.7	0.0	0.1	0.1	-0.7	10/15/99	2.4	3.3	0.0	0.1	0.8	-1.8
10/16/99	2.4	2.8	0.3	0.0	-0.5	0.4	10/16/99	2.6	4.1	0.3	0.0	-0.2	-1.1
10/17/99	2.3	2.3	0.0	0.0	0.1	-0.1	10/17/99	2.4	4.0	0.0	0.0	-0.7	-0.9
10/18/99	2.2	2.5	0.0	0.1	-0.3	0.0	10/18/99	2.3	3.3	0.0	0.1	0.0	-1.0
10/19/99	2.3	2.2	0.0	1.1	-0.1	-0.9	10/19/99	2.3	3.3	0.0	1.1	-0.1	-1.9
10/20/99	2.3	2.2	0.0	0.1	-0.1	0.2	10/20/99	2.4	3.2	0.0	0.1	-0.6	-0.3
10/21/99	2.3	2.1	0.0	0.0	0.0	0.2	10/21/99	2.4	2.6	0.0	0.0	0.1	-0.3
10/22/99	2.3	2.1	0.1	0.0	0.0	0.3	10/22/99	2.3	2.7	0.1	0.0	-0.1	-0.2
10/23/99	2.2	2.1	0.0	0.0	0.2	-0.1	10/23/99	2.2	2.6	0.0	0.0	-0.2	-0.2
10/24/99	1.7	2.2	0.0	0.0	-0.2	-0.4	10/24/99	1.7	2.3	0.0	0.0	-0.6	-0.1
10/25/99	2.5	2.1	0.0	0.1	-0.1	0.5	10/25/99	2.6	1.8	0.0	0.1	-0.3	1.0
10/26/99	2.5	2.0	0.0	0.0	0.0	0.5	10/26/99	2.6	1.5	0.0	0.0	-0.1	1.1
10/27/99	2.5	2.0	0.0	0.0	0.1	0.4	10/27/99	2.6	1.4	0.0	0.0	0.0	1.1
10/28/99	2.6	2.1	0.0	0.1	0.0	0.4	10/28/99	2.6	1.4	0.0	0.1	0.0	1.2
10/29/99	2.8	2.1	0.0	0.1	0.2	0.4	10/29/99	2.9	1.4	0.0	0.1	0.1	1.4
10/30/99	2.8	2.3	0.0	0.5	0.2	-0.2	10/30/99	2.9	1.4	0.0	0.5	0.0	0.9
10/31/99	2.9	2.5	0.0	0.0	0.0	0.4	10/31/99	3.0	1.4	0.0	0.0	0.0	1.5
11/1/99	2.9	2.5	3.1	0.0	0.1	3.3	11/1/99	2.9	1.4	3.1	0.0	0.0	4.5
11/2/99	2.3	2.6	0.2	0.0	0.1	-0.2	11/2/99	2.3	1.4	0.2	0.0	0.1	0.9
11/3/99	2.1	2.7	0.0	0.0	1.0	-1.6	11/3/99	2.0	1.5	0.0	0.0	1.5	-1.0
11/4/99	2.4	3.7	0.0	0.0	0.1	-1.4	11/4/99	2.4	3.0	0.0	0.0	1.1	-1.7
11/5/99	2.1	3.8	0.0	0.1	-0.2	-1.6	11/5/99	2.0	4.1	0.0	0.1	-0.3	-1.9
11/6/99	2.0	3.6	0.0	0.0	-0.7	-0.9	11/6/99	1.9	3.8	0.0	0.0	-0.6	-1.3
11/7/99	2.1	2.9	0.0	0.1	-0.2	-0.8	11/7/99	1.9	3.2	0.0	0.1	-0.4	-1.0
11/8/99	2.1	2.8	0.0	0.1	-0.2	-0.6	11/8/99	1.9	2.9	0.0	0.1	-0.2	-0.8
11/9/99	2.1	2.6	0.0	0.0	-0.4	-0.1	11/9/99	1.9	2.7	0.0	0.0	-0.4	-0.4
11/10/99	2.1	2.2	0.0	0.0	0.0	0.0	11/10/99	2.0	2.3	0.0	0.0	-0.1	-0.2
11/11/99	2.1	2.2	0.0	0.0	-0.2	0.0	11/11/99	1.9	2.2	0.0	0.0	-0.7	0.4
11/12/99	2.2	2.0	0.0	0.0	-0.1	0.2	11/12/99	1.4	1.5	0.0	0.0	0.0	-0.1
11/13/99	3.0	2.0	0.0	0.5	0.0	0.4	11/13/99	0.7	1.6	0.0	0.5	0.5	-1.9
11/14/99	4.1	2.0	0.0	0.1	0.0	2.0	11/14/99	3.2	2.1	0.0	0.1	-0.2	1.3
11/15/99	8.4	2.0	0.0	0.2	-0.2	6.5	11/15/99	10.6	1.9	0.0	0.2	-0.1	8.7
11/16/99	6.5	1.8	0.0	0.0	0.4	4.2	11/16/99	8.2	1.8	0.0	0.0	0.6	5.7
11/17/99	4.7	2.2	0.0	0.1	2.9	-0.6	11/17/99	4.7	2.4	0.0	0.1	3.6	-1.4
11/18/99	5.1	5.2	0.0	0.0	0.7	-0.8	11/18/99	5.0	6.0	0.0	0.0	0.6	-1.6
11/19/99	8.5	5.9	0.1	0.0	0.2	2.6	11/19/99	9.7	6.6	0.1	0.0	-0.4	3.6
11/20/99	24.3	6.1	0.0	0.0	-0.6	18.8	11/20/99	18.4	6.2	0.0	0.0	-0.4	12.7
11/21/99	5.4	5.5	0.0	0.1	0.9	-1.1	11/21/99	12.7	5.8	0.0	0.1	0.2	6.7
11/22/99	12.0	6.4	0.0	0.3	4.3	1.0	11/22/99	7.1	6.0	0.0	0.3	4.7	-4.0
11/23/99	2.2	10.7	0.1	0.0	0.7	-9.1	11/23/99	2.1	10.7	0.1	0.0	0.3	-8.8
11/24/99	5.5	11.4	0.2	0.0	-1.8	-3.9	11/24/99	5.5	11.1	0.2	0.0	-0.4	-5.0
11/25/99	5.9	9.6	1.0	0.0	-2.1	-0.5	11/25/99	6.0	10.7	1.0	0.0	-0.3	-3.4
11/26/99	5.9	7.5	0.0	0.0	0.1	-1.6	11/26/99	5.9	10.4	0.0	0.0	1.0	-5.4

	W 1, cm						W 2, cm					
Date	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.	Inf.	Outf.	Precip.	Evap.	ΔVol.	Seep.
11/27/99	6.1	7.5	0.0	0.1	1.2	-2.8	6.1	11.4	0.0	0.1	1.3	-6.7
11/28/99	6.3	8.7	0.0	0.0	1.1	-3.6	6.3	12.6	0.0	0.0	1.0	-7.4
11/29/99	6.1	9.9	0.0	0.1	0.3	-4.2	6.0	13.7	0.0	0.1	-0.2	-7.6
11/30/99	6.0	10.2	0.0	0.0	1.5	-5.7	6.0	13.5	0.0	0.0	-1.8	-5.7
12/1/99	5.9	11.7	0.0	0.0	1.0	-6.8	5.8	11.7	0.0	0.0	1.0	-6.9
12/2/99	5.9	12.7	0.0	0.0	-2.2	-4.6	5.8	12.7	0.0	0.0	-2.2	-4.6
12/3/99	5.6	10.5	0.0	0.0	-0.6	-4.2	5.7	10.5	0.0	0.0	-0.6	-4.2
12/4/99	5.7	9.9	0.7	0.0	-0.2	-3.3	5.7	9.9	0.7	0.0	-0.2	-3.3
12/5/99	5.9	9.7	0.0	0.0	0.7	-4.4	5.8	9.7	0.0	0.0	0.7	-4.5
12/6/99	5.8	10.3	0.0	0.0	0.0	-4.5	5.7	10.3	0.0	0.0	0.0	-4.6
12/7/99	6.1	10.3	0.0	0.0	0.4	-4.6	5.9	10.3	0.0	0.0	0.4	-4.8
12/8/99	6.1	10.7	0.0	0.1	-0.4	-4.3	5.9	10.7	0.0	0.1	-0.4	-4.4
12/9/99	6.1	10.3	1.6	0.0	0.0	-2.6	6.0	10.3	1.6	0.0	0.0	-2.7
12/10/99	6.0	10.3	0.0	0.0	0.3	-4.6	5.8	10.3	0.0	0.0	0.3	-4.8
12/11/99	6.8	10.6	0.6	0.0	0.7	-3.9	6.6	10.6	0.6	0.0	0.7	-4.0
12/12/99	6.8	11.3	0.4	0.0	1.7	-5.8	7.3	11.3	0.4	0.0	1.7	-5.3
12/13/99	22.6	13.0	2.8	0.0	0.6	11.8	21.2	13.0	2.8	0.0	0.6	10.4
12/14/99	18.5	13.6	0.0	0.0	1.4	3.4	20.1	13.6	0.0	0.0	1.4	5.1
12/15/99	22.3	15.1	0.0	0.0	1.9	5.4	37.0	15.1	0.0	0.0	1.9	20.0
12/16/99	20.8	17.0	0.0	0.0	7.7	-3.9	41.6	17.0	0.0	0.0	7.7	16.9
12/17/99	24.2	24.7	0.0	0.0	-2.2	1.8	25.7	24.7	0.0	0.0	-2.2	3.2
12/18/99	23.0	22.4	0.0	0.0	-3.3	3.8	31.1	22.4	0.0	0.0	-3.3	11.9
12/19/99	19.3	19.2	0.2	0.0	-2.2	2.5	20.9	19.2	0.2	0.0	-2.2	4.1
12/20/99	17.8	17.0	0.0	0.0	-3.3	4.1	19.1	17.0	0.0	0.0	-3.3	5.5
12/21/99	14.0	13.7	0.0	0.2	0.5	-0.5	12.1	13.7	0.0	0.2	0.5	-2.3
12/22/99	14.3	14.2	0.0	0.1	-2.2	2.1	11.7	14.2	0.0	0.1	-2.2	-0.5
12/23/99	12.3	12.0	0.0	0.1	-0.5	0.7	10.1	12.0	0.0	0.1	-0.5	-1.5
12/24/99	11.8	11.5	0.0	0.1	0.5	-0.3	9.8	11.5	0.0	0.1	0.5	-2.3
12/25/99	12.5	12.0	0.0	0.0	2.7	-2.3	10.8	12.0	0.0	0.0	2.7	-4.0
12/26/99	15.5	14.8	0.0	0.0	-2.2	3.0	10.3	14.8	0.0	0.0	-2.2	-2.3
12/27/99	12.9	12.6	0.0	0.0	-1.6	1.9	9.8	12.6	0.0	0.0	-1.6	-1.1
12/28/99	10.8	11.0	0.2	0.1	-0.5	0.5	15.3	11.0	0.2	0.1	-0.5	5.1
12/29/99	9.8	10.4	0.0	0.1	-5.5	4.8	22.4	10.4	0.0	0.1	-2.2	14.1
12/30/99	4.5	4.9	0.0	0.0	-1.1	0.6	9.0	8.2	0.0	0.0	0.0	0.8
12/31/99	2.8	3.8	0.0	0.0	0.0	-1.0	2.8	8.2	0.0	0.0	-8.2	2.8